High-Efficiency High-Capacity Cooling and Refrigeration System

Benefits

- Potentially saves 1,330 kWh per year for each 12,000 Btu/hr unit in use
- May be capable of providing 30 to 40 percent greater cooling capacity with 5 to 10 percent more energy efficiency than conventional cooling systems
- Nonflammable; low toxicity; environmentally friendly
- Excellent heat-transfer properties, enabling use of a smaller evaporator
- Better energy efficiency than R-12, R-123, and R-134a refrigerants and a volumetric cooling capacity at least equal to that of R-22
- Capable of being retrofit to existing systems or designed into new systems

Applications

The high-efficiency high-capacity cooling and refrigeration system represents a radical breakaway from conventional cooling and refrigeration technology. Though initially designed for upgrades of existing equipment, the technology is soon expected to be applicable to new systems as well. Successful completion of development goals will result in a system appropriate for industrial, commercial, and residential applications.

A simple but ingenious modification to the basic refrigeration cycle promises significantly greater capacity and energy efficiency

Modern expansion/condensation-cycle cooling systems have a long history of reliable use. However, their energy efficiency is limited both by the physical constraints of their mechanical components and by the absolute efficiency of the reverse Carnot cycle. Because of these limitations, future efficiency improvements are expected to be relatively small.

Cooling and refrigeration systems are also limited by their capacity, which is partly dependent on the cooling capacity of the refrigerant. Because of the relationship between heat of vaporization and vapor pressure, high-capacity refrigerants tend to have lower energy efficiencies. Yet high capacity is key in many applications involving fast cooldown times or variable loads.

In response to these system restrictions, Environmental Technology and Education Center (ETEC) of Albuquerque, New Mexico, has developed a nonflammable, low-toxicity, environmentally friendly refrigerant system that represents a new approach to cooling technology. Early research results indicate ETEC's approach provides greater cooling capacity, while simultaneously increasing efficiency. If continued development efforts are successful, ETEC is confident the resulting innovation will be applicable in both new and existing cooling systems at the industrial, commercial, and residential levels.

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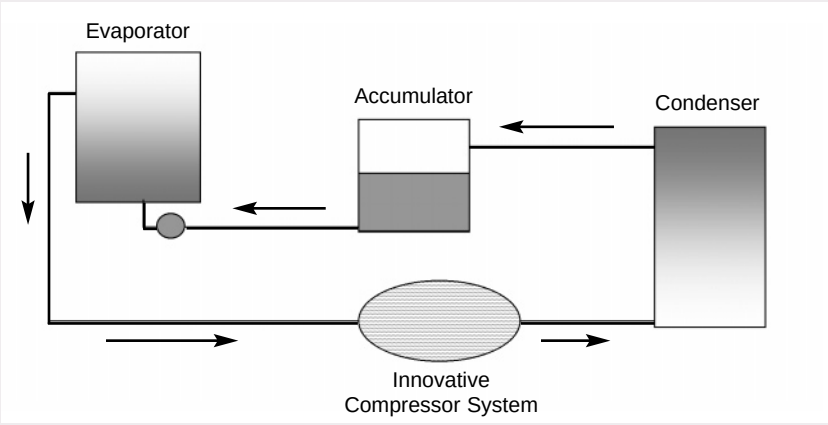


This new cooling and refrigeration system could provide up to 40 percent greater cooling capacity than conventional systems while increasing energy efficiency up to 10 percent.

Project Description

Goal: Produce and test a prototype model of the technology and to move the product to commercialization.

The high-efficiency high-capacity cooling and refrigeration system represents true innovation in a technology area where further improvements are needed, but are at least temporarily stymied by system constraints. In particular, high-capacity refrigerants are typically less efficient because the compressor must work harder to maintain pressure differences.

In comparison, this new technology—a proprietary combination of substances selected for their ability to interact in a desired manner—produces higher volumetric capacity in the evaporator, but lower energy use in compression. Also, because of the compound's excellent heat-transfer capabilities, heat transfer in the evaporator should be superior to that of conventional cooling systems, thereby allowing a smaller evaporator to be used.

While a standard cooling unit operates at about 70 percent efficiency, this new technology is expected to add as much as 50 percent volumetric capacity, while operating at 90 percent efficiency. Even at a more conservative 40 percent capacity increase, the system's efficiency would jump almost 6 percent.

Environmental Technology and Education Center is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the Department of Energy's Office of Industrial Technologies.

Progress and Milestones

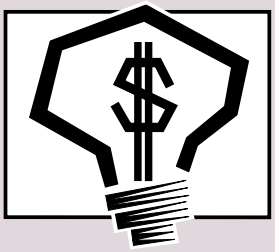
- The proposed system has been proven to be scientifically valid and now ETEC is moving to demonstrate that a commercial product can be developed from the proven concept. Bench-top testing will confirm and pinpoint the cooling capacity and energy efficiency gains, and cost/benefit calculations will be conducted over the full range of possible cooling applications.
- ETEC has identified potential partners in the investment-casting and plastics industries.
- Under the Inventions and Innovation grant, the technology progressed from the "Conceptual" to the "Technical Feasibility" stage of new product development.

Economics and Commercial Potential

The energy and economic savings potential of the high-efficiency high-capacity cooling and refrigeration system is dramatic:

- An estimated 60 billion kWh of electricity are used each year for industrial process cooling and refrigeration and facilities cooling. Saving 10 percent of this energy at a targeted 33 percent market penetration would save 10 trillion Btu annually.
- In 1992, commercial buildings consumed 5,490 trillion Btu of energy. Commercial space is projected to double by the year 2010. If just 25 percent of the commercial sector's energy use is for cooling, a similar 33 percent market penetration would save an estimated 21 trillion Btu annually.
- 1990 saw approximately 113 million refrigerators and 32 million freezers operating in the residential sector, representing total energy consumption of approximately 640 trillion Btu each year. An estimated 11 million new refrigerators and freezers are added each year. Assuming 35 percent market penetration in just the new units sold each year would yield savings of 21 trillion Btu annually by the year 2010.

Altogether, the subject technology could yield energy savings of 52 trillion Btu per year, or the equivalent of nearly 9 million barrels of oil.



The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

Project Partners

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